Resistance to Pear Psylla Nymphal Feeding of Germplasm from Central Europe

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Abstract

Pear psylla (*Cacopsylla pyricola* Foërster) is the most serious pest of the European pear (*Pyrus communis* L.) in the production regions of Europe and North America. Nine plant germplasm introductions of pear from Central Europe recently released from plant quarantine were evaluated for nymphal feeding antixenosis, a primary mode of resistance known to be correlated with ovipositional antixenosis and antibiosis (i.e. nymphal mortality and reduced developmental rate). Five single-shoot budded trees were grown in the greenhouse without pesticide application. The top two youngest fully expanded leaves were infested with ten 2nd and 3rd instar nymphs from a young laboratory colony. The number of surviving nymphs and the number of actively feeding nymphs was recorded after two days. Three cultivars from Yugoslavia, 'Karamanka', 'Jerisbasma', and 'Vodenjac', plus NY 10353 (a resistant control of *P. ussuriensis* Max. ancestry) were significantly more resistant to nymphal feeding than the susceptible control, 'Bartlett', and the cultivars 'Junsko Zlato', 'Lida', 'Orlovskaya', 'Oranzhevaja', 'Nadejda', and the selection IV 12. These objective data confirm field observations made in Europe of the Yugoslavian cultivars, and increases the number of psylla-resistant genotypes available for breeding new cultivars.

INTRODUCTION

The pear psylla (*Cacopsylla pyricola* Foërster syn., *Psylla pyricola* Foërster, *P. pyri* L., and *P. pyrisuga* Foerster) is a serious insect pest of the cultivated European pear (*Pyrus communis* L.) in the production regions of North America and Europe. The insect has rapidly developed resistance to most of the pesticides employed for control and biological controls alone have rarely provided sufficient control for commercial production. The annual cost of chemical control exceeds $300 per acre. Cultivars with durable resistance would enhance the economic and environmental sustainability of pear production by reducing producer costs and pesticide use.

These species of pear psylla and their host apparently coevolved in Europe. Early investigations of western European cultivars identified only a single moderately resistant cultivar, the old Italian pear 'Spina Carpi' (Quarta and Puggioni, 1985). Pomologists and breeders have been collecting wild germplasm and landrace cultivars in order to identify diverse sources of resistance for use in the development of new, but psylla-resistant, cultivars. The present research is a continuation of an investigation of the *Pyrus* gene pool of eastern and central Europe as a source of resistance (Bell, 1991, 1992; Bell and Stuart, 1990; Puterka et al., 1993).

MATERIALS AND METHODS

Germplasm

Nine recent germplasm introductions of pear from central Europe, plus 'Bartlett' as a susceptible control and NY 10353 (a *P. ussuriensis* × *P. communis* BC_1 hybrid) as a resistant control (Table 1).

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Resistance Assay

Nymphal feeding antixenosis (i.e. feeding inhibition) is a primary mode of resistance, and is known to be highly correlated with ovipositional antixenosis and antibiosis, the latter measured as nymphal mortality and delayed development (Bell, 1991; Butt et al., 1989). Five single-shoot plants of each genotype budded on 'Bartlett' seedling rootstock were grown in a pesticide-free greenhouse. The top two youngest, fully expanded leaves of each plant were each infested on the underside with ten 2^{nd} or 3^{rd} instar nymphs from a young laboratory colony of pear psylla (*C. pyricola*). All but the top four leaves were removed. After infestation, the plants were maintained in a growth chamber at 25 ± 1°C and a photoperiod of 16 hr/8 hr (L/D) provided by incandescent and high intensity fluorescent bulbs. The experimental was conducted as a randomized complete block design of five independent infestations (trials). The number of surviving and the number of actively feeding nymphs were counted after two days. Active feeding was indicated by the presence of secreted "honeydew".

Statistical Analysis

Homogeneity of variance was tested by Bartlett's test and normality of residuals was tested by the Shapiro-Wilk W statistic. Data transformation was found to be unnecessary. The data was analyzed as a mixed model, with trial as the random factor, using SAS PROC MIXED (Littell et al., 1996). Differences in means were tests using the default protected lsd test. The correlation between genotypic means for number of nymphs alive on each plant and the number feeding was computed by Pearson's test.

RESULTS AND DISCUSSION

There were no significant differences among genotypes in the number of nymphs present and alive after two days (Table 2). However, differences in mortality usually are not evident for several days (Butt et al., 1989). Three cultivars from Serbia, 'Karamanka', 'Jeribasma', and 'Vodenjac', and the resistant selection NY10353, were significantly more resistant to nymphal feeding than the susceptible control, 'Bartlett', and the other six genotypes (Table 2). The correlation between genotypic means for number alive and number feeding was 0.6 ($p = 0.052$). These results confirm prior observations made during collection of the resistance of the Serbian germplasm (van der Zwet et al., 1987). 'Jeribasma' and 'Vodenjac' are thought to be synonymous genotypes, and is mirrored in the similarity of their assay results. The total number of psylla resistant *P. communis* germplasm accessions identified from collections and acquisitions in central and eastern Europe now is thirteen. This research has increased the number of genotypes available for the development of new European pear cultivars with resistance to pear psylla.

Literature Cited

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Tables

Table 1. *Pyrus* germplasm and their origins.

Genotype	Plant Introduction or Quarantine No.	Country of origin
Bartlett	--	England
IV 12	Q 26671	Serbia
Jeribasma	PI 617615	Serbia
Karamanka	T22093F	Serbia
Junsko Zlato	PI 617620	Serbia
Lida	PI 617609	Russian Federation
Nadezda	PI 617611	Russian Federation
Oranzhevaja	PI 617612	Russian Federation
Orlovskaja	PI 617610	Russian Federation
Vodenjac	PI 617614	Serbia
NY 10353	--	USA (Cornell Univ.)

Table 2. Mean numbers of nymphs alive and feeding.

Genotype	No. alive	No. feeding[1]
Junsko Zlato	15.6	12.9 a
Lida	15.8	12.4 a
Bartlett	15.2	12.2 a
Orlovskaja	16.4	12.2 a
IV 12	14.6	11.0 a
Oranzhevaya	15.4	10.6 a
Nadezda	16.0	10.4 a
Karamanka	11.6	5.4 b
NY 10353	14.4	5.4 b
Jeribasma	13.1	4.9 b
Vodenjac	15.6	3.4 b

[1]Numbers followed by the same letter are not significantly different at the 5% level.